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COSTS OF ESTABLISHING AND OPERATING CONTAINER NURSERIES IN U.S.D.A. CLIMATIC ZONE SIX DIFFERENTIATED BY SIZE OF FIRM AND SPECIES OF PLANT

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INTRODUCTION

Nurserymen throughout the United States have been gradually shifting from field to container production for many species of plants. Containers allow greater flexibility in production and marketing and in most cases are less expensive than field production (9). Consequently, they have encouraged large companies to enter production and marketing. The result has been escalating competition and narrowing profit margins. Most nurserymen also lack the necessary expertise to systematically determine production costs. Due to increasing competition and periodically a slack economy many nursery operators find themselves in a precarious financial position. Survival under these conditions requires excellent production and marketing procedures. The purpose of this research was to provide nursery operators with production and financial information for decision making. This information should prove especially useful to individuals anticipating beginning a container nursery and to present field operators anticipating expanding to containers. It should also prove useful to present nurserymen with container operations who anticipate updating and expansion. Another value would be in identifying segments within present operations that might be providing bottlenecks which result in cost inefficiencies.

Cost models have recently been developed for several species of plants in other regional areas (1,2,3,4,5,7,8). An initial cost model for Ohio was developed by Powers (10) which provided excellent information . However, it did not include overhead costs or information on physical coefficients. The lack of physical coefficients makes it very difficult to update the information without resurveying Nurserymen. Development of complete cost models for zone six nurserymen would provide a standard against which they could compare their own operations. This type of information would allow present or potential U.S.D.A. zone six nurserymen to make more informed decisions as to whether to enter, leave, or expand container production.

OBJECTIVES

The general objective of this study was to develop model commercial sized container nurseries for U.S.D.A. climatic zone six using the conceptual framework of economic engineering wherein the 'best proven practice' would be utilized in each model. Specific objectives were to:

1. Develop a production system that would accomodate the majority of species of containerized plants being grown in the area.

2. Design physical facilities including land areas, land improvements, irrigation systems, buildings, machine and equipment components, for two different sized commercial container nurseries based on the choosen production system. The smaller unit to be of a size that could hopefully provide an economic unit for a family operation and the larger to be twice as large as the smaller in growing area.

3. Analyze the various species of plants commonly grown in containers in the area as to growing and production requirements and assign them to groups based on similiarities. Choose one species from each group as representative of the group for specific cost of production analysis.

4. Develop cost of production budgets for the selected species from each production group based on the choosen production system and the synthesized model nurseries.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model. They were synthesized based on the Columbus, Ohio area. The complete synthesis included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation system; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with the purchase of plant liners and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs (9).

Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1982. The basic goals in synthesizing the production facilities (see Figures 1 and 2) were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and keep future expansion possible.

Production System

The production system chosen for this analysis is described in detail in Appendix A. Essentially it consists of utilizing husky two or three year old bareroot liners to produce a salable plant within two growing seasons. These 6-7" liners are transplanted directly into two gallon (8-1/2" x 8") copolymer containers during the month of May. Approximately 10% of the crop will be sold during the fall of the second growing season (approximately 18 months), 50% during March and April after the second growing season (approximately 22-23 months), and 10% during May after the second growing season (24 months). May is a period when clean-up sales are being made and new plants started. This production system saves transplanting as the plants are sold in the same containers they are started in (two gallon).

Physical Plant and Equipment

Assumptions

Assumptions made regarding physical plant and equipment can greatly affect its cost and thereby cost per annual salable plant. The authors were carefull to include all items a nursery would typically require. As a result, the physical plant is probably more elaborate than many nurserymen would require. A nurseryman can quite easily remove or reduce an item if he feels it is not needed or if

he requires less of it. On the other hand, it would require substantial effort to do the analysis on his own if it were not included. Some specific assumptions that add substantially to a "stripped down" facility are as follows:

Scale of Nursery Operation. It was assumed that the model nurseries would be self sufficient. Most nurserymen with container operations also have field production with buildings, machinery and equipment being shared between operations. Shared facilities would significantly reduce costs associated with the container operations.

Site. The site chosen would be typical for the area in regards to soil drainage conditions and access to water. This situation requires considerable site preparation, costing several times land acquisition costs plus the drilling of a well. Many of these costs could be eliminated or reduced if the nursery were located on gravelly or sandy soil with good natural drainage. Locating near a river or other natural water source could reduce the need for a well.

Expansion. Expansion was provided for, especially in case of the smaller nursery. It became obvious very quickly in the analysis that buildings, machinery and equipment needed for an efficient operation in the small nursery were adequate for a much larger system. A significant stumbling block to expansion, if just an adequate system were provided, would be in the irrigation components. For this reason, a larger irrigation pump, larger well casing diameter, and larger in-ground water mains were provided. The small nursery could be expanded at least to the size of the larger with very little effort. While expansion was also provided for the larger nursery, it was much less than for the small. It was felt that if the larger nursery were to get much larger it would start running into other "limiting factors" much faster than in the case of the small nursery. The assumption regarding different expandability factors for the two sized nurseries builds some bias into the analyses in favor of the large nursery when comparing costs per salable plant between the two sized nurseries.

Machinery and Equipment. New machinery and equipment were provided for the model nurseries. Many nurserymen could well have access to used equipment. Another possibility would be rental of equipment or the sharing of expensive items with other nurseries.

General

A model facility was synthesized for both a small (340,000 sq ft of growing area, Fig. 1) and a large (680,000 sq ft of growing area, Fig. 2) container nursery. Both

models were designed with expansion in mind. For example, the small nursery has a centrally located shipping and "order building area" for four semi-truck loads of plant material surrounded by growing area (Fig. 1). When the need for expansion occurs, the firm can expand with a minimum of disruptions. If it were desired to double growing space, the six polyhouse structures in the larger shipping area and three polyhouses in the pond expansion area would be reconstructed around the firm's perimeter with an additional 51 houses. Expansion for the large nursery would occur in essentially the same manner (Fig. 2). Specific components for both sized nurseries are itemized in Tables 1 and 1a.

The same buildings and to a lesser degree machinery and equipment needed for the small nursery also met requirements for the large one. Most of the machinery and equipment, even in the large nursery, is under-used but must be available when needed.

Components

Land Improvement. To enable fullest utilization of the growing and shipping area, extensive grading, graveling, surface and underground tiles were provided to ensure proper drainage (Table 2). The growing area was graded to allow for a gradual sloping of the land from a high point at the shipping area to lower points on the extremes of the growing area. In addition, every two rows of polyhouses were sloped toward each other to utilize a common buried 30-inch water tile that attaches to the open grassy waterways at the perimeter of the container operation.

Due to heavy irrigation needs of containerized plants, especially with utilization of overhead sprinkler systems, the problem of ground erosion occurs. Even with low application rates of .25 inches of water per hour, the need to allow for base soil saturation and the possibility of heavy natural rainfall necessitates gravelling production and shipping areas. For any area that heavy equipment may run over; roadways, shipping area and machine storage shed, #4 grade gravel was used. In other graveled areas, #8 grade was utilized. Although the cost of this gravelling operation is high, it is offset by greater efficiencies and dependability in the handling of plants, ability to reenter the growing areas after natural or artificial irrigation and reduction in soil erosion.

A pond was included even though it was assumed a well could be dug with sufficient regenerative water capacity. This was done to reduce the risk to plants in containers in

case of disruptions caused by repairs or electrical failure. In the small operation, for example, a partially above ground pond (80′ x 120′) was provided as a temporary holding area. This capacity would provide for irrigation needs for approximately 1 week. An auxiliary take-off drive from the pump could be powered by a large 60 HP tractor for temporary irrigation. The pond also functions as a discharge site when operating the pump at higher efficiency levels but not needing the total water being drawn for present irrigation purposes. The grass perimeter maintains an aesthetically pleasing view and allows for excess water runoff.

Buildings. Each nursery was assumed to require similar sized permanent buildings for the receiving of nursery stock/storage (50′ x 40′), machinery repair/storage (50′ x 40′), office space (20′ x 20′), and restroom facilities (20′ x 20′).

Overwintering facilities. The need for overwintering facilities (polyhouse structures) was a primary concern in the development of the production operation. Individual crop storage spacing needs can be a limiting factor to the number of units a given production acreage is able to produce (Tables 6,6a). Polyhouse structures measuring 20′ x 200′ were choosen for the nurseries (Table 3). These structures are quite a bit larger than the traditional 14′ x 96′, but allow easier access and use of machinery. Cost per sq ft is essentially the same as for smaller structures. It should be noted, however, that in areas of heavy snowfall and/or high winds, the smaller sized structure might be more stable. To minimize physical movement of plants, yet maximize production of salable plants, a three-two growing plan (three polyhouses with two growing spaces between the individual polyhouses) was utilized. Once in containers, only 20% of the newly planted crop has to be moved during the first growing season. At the beginning of the second growing season, the close-spaced units and 20% of the newly containerized units will be moved into the opened overwintered areas once occupied by the recently shipped salable units and the growing spaces between polyhouses. Flanking either side of the three-two growing plan are common access roadways 20 feet in width that are needed for the spray program, plant/polyhouse inspection, and order pulling operations.

Irrigation system. Irrigation systems were designed to minimize labor efforts, yet provide sufficient irrigation capabilities to meet present and future water needs even under the most unlikely situations. A basic irrigation system is composed of four parts: water source, pumping equipment, inground irrigation pipe, and above ground irrigation pipe (Table 4).

The water source must have adequate reserves to meet maximum water needs and sufficient purity to meet cultural requirements. Due to the expense of municipal water, especially if the production site is located far from a center of population; a well in conjunction with a constructed lake or a site situated near an open water source would be desirable. The open water source would have to be choosen with care. Most open water sources have problems due to the collection of water from many sources. Also, present/future demands made by industries downstream or upstream may adversely affect flow rates and chemical composition of the water. Construction requirements for a pond or lake are sufficient holding capacity to meet potential water demands and an adequate water supply furnished either by water shed areas, tappable underground water, springs, or some other source. Our models assumed an adequate water source found approximately 50-80 feet below ground.

Selection of an adequate well pump is crucial to the nursery operation. The following factors should be considered in the selection: area to be irrigated at one time, pressure requirements of sprinkler heads, pressure losses due to water friction in pipe diameter, pipe length, accessory values and future expansion. As a basic guideline, the maximum pressure loss from entrance point to the farthest point of irrigation within a lateral should be under 20 percent of the psi reading as found at the pump. This assures a constant rate of application from all sprinkler heads on the line. The second guideline is that the combined amount of water exiting from the sprinklers used at one irrigation setting must be less than the total flow of water coming from the pump. A 75 HP electric-run pump was budgeted for driving the water from an 80 foot well depth (Table 5). It provides 900 gallons of water per minute at 55 to 60 pounds per square inch pressure (psi). This properly meets sprinkler head requirements, and also provides for future expansion. The well depth depends not only on the depth the water is found at but also on the amount of water being drawn per minute by the pump. An electric powered motor was chosen because of reliability of performance, low maintenance cost and close availability of three-way electrical power. As preventative measures, the following were provided: a simple housing unit to enclose the pump for protection from environmental elements, a foot value attachment for pumping from the adjacent above ground auxiliary water source, and a right angled gear drive added to the pump in case of a power outage. Using the right angled gear drive, a tractor can power the pump to continue irrigation operations on a limited basis. The pressure and quantity of water needed are dependent upon sprinkler head requirements and the area to be covered at one irrigation setting. Provisions for future

expansion required increased diameter water mains which in turn necessitated a larger irrigation pump than would typically be found in the smaller nursery.

The third part of the irrigation system is the inground irrigation pipe. As seen from Diagram 1, 8" P.V.C. pipe forms major laterals and the basic closed loop system around the shipping area. Although 4" or 6" P.V.C. could have been utilized with certain changes of sprinkler head and above ground pipe size, the 8" size pipe allows for future expansion at a minimal cost difference of about $1.13 per foot installed. For example, if growth is expected to occur to the larger nursery (192,095 two gallon units sold yearly), the cost of relaying pipe and of interrupting production activities certainly is more than offset by the greater initial investment. The advantages of inground water mains are: labor costs for pipe movement is eliminated, breakage due to equipment running over above ground is eliminated and lower initial cost of P.V.C. pipe compared to portable above ground aluminum.

The fourth part of the irrigation system would be above ground and would include 1" frost free water hydrants, 200 feet of 1" P.V.C. pipe per polyhouse or growing space, riser pipe and sprinkler heads. One inch P.V.C. pipe would hang from the apex of the polyhouses. Between polyhouses 1" P.V.C. pipe would lay on the ground with sprinklers on risers steadied by stakes. Sprinkler heads would be spaced at 20 foot intervals, release 1.05 gallons per minute with each covering a maximum 64 foot diameter circle area.

To properly develop a comprehensive irrigation system the following must be considered: water pressure requirements of the sprinkler head, water pressure loss due to pipe and valve friction and area to be irrigated at one time.

Water pressure requirements of the sprinkler head, in price catalogs, is normally specified as a range. Water pressure determines the area covered by the sprinkler. For example, a selected sprinkler head, Rainbird 14VH series with a 5/64" orifice covers a maximum area of 64 foot diameter at a rate of 1.05 gallons per minute under psi conditions of between 35-40. At this rate, it takes five hours to irrigate one inch of water, (1.25 inches per irrigation is needed to achieve one inch equivalent for the plants due to wind and evaporation during water application. Overhead irrigation is only 80 percent efficient for the Midwest region.)

Enterprise Mix

The nursery operations were assumed to produce a diverse line of nursery stock each having a two year production cycle. Commonly grown nursery stock was divided into five

cultural groups. While not all inclusive, the groups do permit a range of per unit costs to be developed as they relate to input costs and cultural factors. For analytical purposes, it was assumed that each cultural group would occupy 20% of the growing area (i.e. small nursery = 68,000 sq ft per group; large nursery = 176,000 sq ft per group). The small container operation would be comprised of 198,745 units in full production and the large operation of 399,160 units. Annual sales capacity for the small operation would be 95,650 units and for the large operation 192,095 units. For detailed analysis, one specific plant from each group was choosen as representative of the group. While it is recognized that other plants from each category would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the plant choosen as representative. The five groups, with some of their cultural characteristics are listed below:

Group	Plant	Cultural Characteristics
I	SPREADING EVERGREENS Juniperus chinensis (varieties) Juniperus horizontalis (varieties) Thuja occ. woodwardi	Hardwood bark medium, minimal overwinter structure, 12-15" salable plants.
II	SPREADING DECIDUOUS SHRUBS Berberis t. 'Crimson Pygmy' Cotoneaster apiculata Cotoneaster horizontalis Cotoneaster dammerii Euonymus fortunei	Hardwood bark medium, maximum overwinter structure, 12-15" salable plants.
III	SLOW GROWING EVERGREENS Taxus (species) Buxus (species)	Pinebark medium, minimal overwinter structure, 12-15" salable plants.
IV	UPRIGHT DECIDUOUS SHRUBS Euonymus alatus compacta Viburnum (species) Weigela Forsythia Ligustrum vicaryi	Hardwood bark medium, minimal overwinter structure, 18-24" salable plants.

V	BROADLEAF EVERGREEN Rhododendron Pieris Pyracantha	Pinebark medium, maximum overwinter structure, 15-18" salable plants.

Production Cost Budgets

Costs were established for all factors of production including management and invested capital. In economic terms, costs associated with factors of production inputted by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested in land, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nurseries were first determined (Tables 1,1a). Second, capital requirements per salable plant capacity by spacing and size of nursery were established (Tables 6,6a). Third, annual fixed costs were calculated (Tables 7,7a). Fourth, annual variable costs were determined for each of the five groupings of plants for each of the two sized nurseries (tables 8 thru 12a). Fifth, summaries were made for annual fixed and variable costs for each of the plant groups according to size of nursery (Tables 14 thru 15a). This allowed cost comparisons based on cultural practices and size of nursery.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. Analyses on a "cash" basis does not give a true economic picture of the cost of producing a plant as it does not take into account the time value of money from the time the plant is planted until it is harvested. The analyses do, however, give a true estimate of the annual cost per salable plant. Another problem with cash accounting is taking into account the start-up period (i.e. the period from when costs are first incurred until salable plants are ready). In this analyses excellent management will be assumed. It will be assumed that land will be purchased, improvements made and crops planted between January and the end of May of the first year). Second, it will be assumed that the total growing area will be planted the first season with one half containing the planted liners as allowed for in the budgets and the other half with larger plants that can reach salable size within one growing season. The only added cost, over the usual annual budgets, would be for the larger plants which would be sold after the first growing season.

Fixed Costs

Annual fixed costs are presented in Tables 7 and 7a. Most of these costs were derived based on the physical plant and equipment discussed previously. There costs were grouped into five categories: land and land improvements, buildings, machinery and equipment, general overhead, and opportunity cost of capital for general overhead, insurance and taxes. Annual fixed costs for land and land improvements, buildings, and machinery and equipment were composed of depreciation, interest, insurance, and taxes. Depreciation was calculated by dividing initial cost adjusted for salvage value by the years of useful life. Interest costs were estimated by multiplying the intitial value of land and land improvements, buildings, machinery, and equipment by 15% per annum. Taxes and insurance costs were based on rates prevailing in the rural areas adjacent to Columbus, Ohio. Land, land improvements, and buildings were assessed taxes at the rate of $20 per $1,000 of market value. Insurance was set at $5.35 per $1,000 of market value for buildings and $4.54 per $1,000 of initial value for equipment. Costs for general overhead were determined on a current basis. Interest charges for general overhead, insurance, and taxes were computed for a 6-month average use period at a rate of 15% per annum.

General overhead. This is a catchall category of items that were not described in detail elsewhere, but which make up a substantial portion of annual fixed costs. These costs can be classified under the following headings: utilities, licenses and bonds, advertising and printing, insurance-personnel, travel and other, professional fees, administrative and management and miscellaneous. Utilities include heat, electricity and telephone services to the production department. It does not include fuel for equipment or machinery. Licenses and bonds are made up of expenses for inspection and certification to sell plants. General maintenance and repairs includes those expenses of maintaining roads and minor repairs to buildings which cannot be capitalized plus maintenance of grounds such as grass cutting and litter pickup. Advertising and printing involves procurement of letterhead items, nursery signs, employee handbooks and want ads for employment. Insurance for personnel includes workmen's compensation, FICA, health insurance, plus unemployment insurance for administration and management personnel (hourly laborers costs are included in hourly rates). Travel and other are made up of expenses to extension workshops, state meetings and regional meetings. Professional fees include membership costs of national, state and local nursery associations. Administrative and

management are made up of salaries or wages of clerical personnel, management and supervisory personnel, and office supplies. Miscellaneous includes replacement of office equipment not depreciable plus unexpected costs. It should be noted that this item could be significantly reduced if many of the costs, especially administrative and management were shared with a field operation.

To determine annual fixed costs per cultural group, total annual fixed costs were simply divided by five. Annual fixed costs per salable plant were then determined by dividing the annual number of salable plants in each group into the annual fixed costs allocated to that group.

Variable Costs

Variable costs include all cost factors that vary with the quantity of plants being grown at one point in time. For example, the number of liners required for spring planting depends upon the quantity of plants management desires to have in inventory plus planting losses. A loss factor of 5% was assumed with 2 1/2% being taken in the first production year and 2 1/2% in the second. Variable costs were subdivided into the following categories: materials, machinery and equipment, labor, and interest on operating capital. These costs were determined for each each group of plants using a specific plant as the representative for the group (Tables 8 thru 12a)

Containers. Container cost was the price of #2 containers plus freight which was estimated at 10 percent.

Soil mixture. A wide variety of growing media is used by nursery producers. While materials budgeted here would provide a good media for the plants under consideration, many producers may prefer a somewhat different mixture. Costs involved are for basic ingredients (sand, hardwood bark, pinebark, soil, vermiculite, haydite, peatmoss), any added micro-elements, chemical additives for bark composting, fertilizers, and freight. All labor and equipment used in mixing or transferring to potting locations is included under labor hours and variable equipment and machinery costs.

Liners. Two costs compose the total for liners. The major cost is the purchase price. While price is somewhat dependent upon quality and quantity, it was assumed that sufficient quality units would be ordered in either sized nursery to obtain them at the lowest possible cost. The second cost was for packing and shipping the liner from producer to purchaser. This was estimated at 10% of the purchase price. In each group of plants the size of liner purchased took into account the objective that each plant was

to be grown in a 2 gallon container for two full growing seasons without becoming pot bound or over grown.

Polyethylene film. The cost of the film delivered to the nursery.

Thermal blankets. Thermal blankets were provided for overwintering groups II (cotoneaster) and V (Rhododendron). Thermal blankets were used in lieu of supplemental heat. Due to the cost of energy, supplementary heat is being phased out in U.S.D.A. Climatic Zone six. It was anticipated that the thermal blankets would be used for three seasons. An individual nurseryman could cut costs in this category if he could use the thermal blankets for additional seasons. Their costs were based upon the delivered price.

Strip tags. Strip tags are provided for identifying plants by botanical name, common name, state plant was grown in, and nursery producer. Costs include printing and shipping charges.

Chemicals. Chemical costs were subdivided into three cultural programs. The first is the herbicide, whose cost is the purchase price of the various pre-emergence and post-emergence materials. The second combines insecticide/miticide/fungicides used to control insect, mite and disease problems. Purchase price reflects total cost for the chemicals as local distributors were assumed. The third is fertilizer. For container operations the purchase price from local suppliers of both soluble and slow release reflect total cost. Due to cultural differences, both group III (Taxus) and IV (Rhododendron) required a more acidified fertilizer with additional iron. This was achieved by using an acidified slow-release fertilizer (Lesco 20-6-12 + Fe). Supplemental liquid fertilization was provided as with groups I, II and IV.

Machinery and equipment. Variable machinery and equipment costs represent all costs incurred while equipment or machinery is in use. These costs are comprised of repair, fuel and lubrication/filter (Table 13). Repair cost per hour was calculated by multiplying initial cost by a stated repair percentage divided by the estimated lifetime use of the machinery in the large nursery in hours. The same repair cost per hour was used for both sized nurseries. Fuel costs were determined by multiplying units of fuel used per hour by the price per unit. Filter/lubrication cost was estimated at a constant factor of 15 percent of calculated fuel cost. Summation of repair, fuel and filter/lubrication costs result in total variable cost per hour of machinery or equipment useage. These costs were divided equally between the five plant groups.

Hourly labor. The following were included in determining total hourly labor charges: basic average hourly wage ($4.30), social security tax "FICA" (6.13% of basis), workmen's compensation (2.71% of basis), general health insurance (3.50% of basis), holiday and vacation pay (4.00% of basis), and unemployment insurance (3.4% for first $6,000 of a persons pay). The total hourly wage including all factors was budgeted at $5.15 per hour. Each major production activity was allocated necessary labor hours to accomplish assigned tasks. Since labor use was dependent upon the number of units produced, they were lower for those plant groups having the fewest number of salable plants.

Cost Summaries

After all cost factors were determined, they were summarized based upon cost per salable plant by group and size of nursery.

RESULTS AND DISCUSSION

Capital Investment Requirements

Capital investment requirements for establishing container nurseries were itemized under three broad divisions: land and improvements, buildings, and machinery and equipment (Tables 1,1a). Each was further divided into several components. The small nursery required $592,921 in investment. Land and land improvements represented 34% or $202,941 of the investment, buildings 35% or $206,243, and machinery and equipment 31% or $183,737. The large nursery had an initial investment requirement of $964,574. Land and land improvements represented 40% or $387,428 of the investment, buildings 33% or $318,108, and machinery and equipment 27% or $259,038. The difference in the percent of total investment between the various components of the two nurseries was primarily caused by the larger nursery being able to make more efficient use of buildings, machinery, and equipment than the smaller nursery. Both nurseries were about equally efficient in the use of growing space.

Land improvement costs, including the pond, were between 5 and 6 times as expensive as the land itself (Tables 1,1a,2). These expenses would be necessary in 'normal' U.S.D.A. climatic zone six areas to provide drainage, water storage, and a good work area in times of inclement weather.

Building needs included a simple office layout, a potting shed for nursery stock receipt and storage, machinery shop for repairs and storage, and polyhouses for overwintering. Details on polyhouse construction are included in Table 3 and those for the irrigation system including the pump and well are found in Tables 4 and 5.

An important consideration for managers in most industries is determination of investment per unit of production capacity. For container nurseries this indicator would be the capital requirement per-salable-plant capacity. This indicator was determined for each of the five groups of plants (Tables 6,6a). To determine this figure it was necessary to determine how many salable plants would be produced annually for each group in its allocated 20% of the growing space. This value ranged from a low of 13,050 for Group V (Rhododendron) to 25,600 for Group I (Juniperus) in the small nursery and from 26,095 to 52,000 in the large nursery for the same two groups respectively. The number of plants grown per unit of space directly relates to the capital requirements per-salable-plant. These costs for the small nursery differentiated by plant group were: $4.63 for group I (Juniperus), $5.72 for Group II (Cotoneaster), $5.90 for Group III (Taxus), $7.33 for Group IV (Viburnum) and $9.09 for Group V (Rhododendron). The average for all groups

was $6.20. For the large nursery the respective figures were: $3.71 for Group I , $4.65 for Group II , $4.80 for Group III , $5.96 for Group IV , and $7.39 for Group V . The average for all groups was $5.02. It was approximately 32% less expensive to provide salable plant capacity in the large nursery than in the small.

Investment requirements of two different container nurseries for U.S.D.A. climatic zone six conditions were examined. However, an infinite number of sizes could have been analyzed. Examination of the data indicate higher investment costs per unit of salable plant capacity would incur as container nursery size is decreased from the one analyzed. This would be caused by spreading the cost of fixed items such as , buildings, equipment, and machinery over fewer units. Conversely, lower costs per unit of salable plant capacity would be realized for container nurseries larger than those analyzed as the costs of fixed items would be spread over more units.

Individual nurserymen could, of course, experience somewhat different costs than those presented. Individual costs would depend upon variables such as production cycle chosen and ability to bargain with suppliers. The nurseryman also may choose not to provide for future expansion, choose land that would require minimum drainage modifications, reduce optimal growing/overwintering space requirements, or operate used equipment. This analysis assumed average soil conditions, expansion capacity, optimal spacing configuartions, new buildings, equipment and machinery.

Annual Costs

Fixed

Annual fixed costs associated with capital investment including depreciation, interest, insurance and taxes were $139,680 per year for the small nursery. In addition there was $95,025 allocated for general overhead and $7,885 for interest on general overhead, insurance and taxes making a total of $242,590 total fixed costs for the small nursery (Table 7). These costs were divided equally between the five plant groups with each group receiving an assesment of $48,517 (Table 14). It was felt that the most reasonable way of assigning fixed cost is by area rather than plant. Once the physical facility is provided, fixed costs are incurred at essentially the same amount regardless of how the nursery facility is used. On a per-salable-plant basis, there was a considerable difference in annual fixed costs when they were differentiated by plant group (Table 15). In the small nursery, they were: $1.90 for group I (Juniperus), $2.34 for group II (Cotoneaster), $2.42 for group III (Taxus), $3.00

for group IV (Viburnum), and $3.72 for group V (Rhododendron). The average over all groups was $2.53. Annual fixed costs for group V were more than double those for group I. These costs were proportionate to the number of salable plants per annum produced in allocated space. Fixed costs as a percentage of total costs ranged from 42% to 51% in the small nursery averaging 46% across the five groups (Table 15).

For the large nursery, annual fixed costs associated with capital investment; depreciation, interest, insurance and taxes were $228,526. An additional $150,000 was allocated for general overhead and $12,521 for interest on general overhead, insurance, and taxes making a total of $391,047 annual fixed costs for the large nursery (Table 7a). Assessment per plant group was $78,209 (Table 14a). Annual fixed costs per-salable-plant were: $1.50 for group I, $1.89 for group II, $1.95 for group III, $2.42 for group IV, and $3.00 for group V averaging $2.04 over all groups (Table 15a). Fixed costs as a percent of total costs were lower than for the small nursery ranging from 37% to 46% averaging 42% across groups (Table 15a). This lower percentage was associated with the lower capital requirement per salable plant capacity.

Annual fixed costs per-salable-plant were substantially lower for the larger nursery compared to the smaller. For group I the difference was $0.40, for group II $0.45, for group III $0.47, for group IV $0.58 and for group V $0.72 averaging $0.49 accross groups. This approximate 25% gain in efficiency when going from the small to the large nursery is once again attributable to the more efficient use of buildings, machinery, and equipment of the large nursery over the small.

While many nurserymen and/or others concerned with the industry might feel that the reported fixed cost figures ranging from 37% to 51% of total costs depending upon size of firm and species of plant might be high, these percentages would be in line with those for similiar industries when considering new facilities. Brumfield et. al. (6) in a synthesized analyses of overhead costs of greenhouse firms found fixed (overhead) costs as a percent of sales to range from about 45% to over 67% depending on size of firm and market channel. The values of this study are not directly comparable with Brumfield et. al., (percent of total costs versus percent of sales), however if marketing costs and potential profit were taken into account so that a direct comparison could be made, the fixed costs from the Brumfield study would be considerably higher as a percent of total costs than were reported in these analyses.

Nurservmen having established facilities might well consider annual fixed costs to be lower than those reported here. This is especially true if they compute depreciation and repairs on the original value of land improvements, buildings, machinery and equipment and if they place a low value on their own management input. Good management, for planning purposes, however, dictates computing depreciation and repairs on replacement value rather than cost. It also dictates placing a value on managerial time that would be comparable to salaries paid in competitive firms.

Variable

Annual variable costs differentiated by size of firm and plant group are detailed in Tables 8 thru 13. There were substantial differences between plant groups, but little difference by size of nursery.

Total variable costs for the small nursery by plant group were $66,580 for group I (Juniperus), $56,007 for group II (Cotoneaster), $63,536 for group III (Taxus), $46,033 for group IV (Viburnum), and $47,501 for group V (Rhododendron). Total for all groups was $279,657 (Table 14). The difference in total annual variable costs between groups is primarily accounted for by the number of plants in the group. The fewer the plants, the fewer the containers, soil mixture, liners, labor to move containers, etc. On a per-salable-plant basis, the groups practically reversed themselves (Table 15). Annual variable costs by plant were $2.60 for group I, $2.70 for group II, $3.16 for group III, $2.84 for group IV, and $3.64 for group V averaging $2.93 across groups. In groups with fewer plants, greater costs were incurred on a per plant basis for polyethylene film, chemicals, machinery, equipment, and labor. Other variable costs that varied substantially between groups were the cost of liners and for groups II (Cotoneaster) and V (Rhododendron) the addition of thermal blankets for overwintering protection. Variable costs for the small nursery ranged from 49% to 58% of total costs averaging 54% across groups (Table 15).

For the large nursery variable costs by plant group were $211,423 for Group I, $189,005 for group II, $204,128 for group III, $169,124 for group IV, and $172,053 for group V. Total for all groups was $945,733 (Table 14a). On a per-salable-plant basis they were $2.57 for group I, $2.67 for group II, $3.13 for group III, $2.80 for group IV, and $3.60 for group V averaging $2.88 across all groups (Table 15a). Variable costs for the large nursery ranged from 54% to 63% of total costs averaging 58% across all groups.

While fixed cost differentials between size of nursery were substantial, this was not the case with variable costs. The difference for groups I, II, and III was $0.03 and for groups IV and V $0.04.

Total

Total annual costs are the summation of fixed and variable. For the small nursery they were $115,097 for group I (Juniperus), $104,524 for group II (Cotoneaster), $112,053 for group III (Taxus), $94,550 for group IV (Viburnum), and $96,018 for group V (Rhododendron). For all groups they totaled $522,242 (Table 14). On a per-salable-plant basis they were $4.50 for group I, $5.04 for group II, $5.58 for group III, $5.84 for group IV, and $7.36 for group V averaging $5.46 across groups (Table 15).

Total annual costs for the large nursery were $211,423 for group I, $189,005 for group II, $204,128 for group III, $169,124 for group IV, and $172,053 for group V. They totaled $945,733 for all groups (Table 14a). On a per-salable-plant basis they were $4.07 for group I, $4.56 for group II, $5.08 for group III, $5.22 for group IV, and $6.59 for group V averaging $4.92 across all groups (Table 15a).

Differences in total annual costs per salable plant between the two sized nurseries were $0.43 for group I, $0.48 for group II, $0.50 for group III, $0.62 for group IV, and $0.77 for group V averaging $0.54 across all groups. It is important to note that of the total differential, all but three or four cents per group was caused by fixed costs. This means that fixed costs accounted for over 90% and variable costs less than 10% of the cost differentials per-salable-plant between the two sized nurseries. For nurseries of the sizes annalyzed, economies of size are achieved in fixed rather than variable costs. Variable costs presented should be quite representative for zone six nurseries doing a good job of management

SUMMARY AND IMPLICATIONS

Large sized commercial container nurseries are able to make more efficient use of buildings, equipment, and machinery than small container nurseries. This results in large nurseries having a lower cost per salable plant. Most commercial nurseries are similar in efficiency factors relative to growing space.

Total annual costs per salable plant in the small nursery differentiated by species ranged from $4.50 to $7.36 averaging $5.46 across species. In the large nursery comparable values were $4.07, $6.59, and $4.92. Over 90% of the differential noted between the two sized nurseries can be attributed to fixed costs.

Fixed costs per salable plant in the small nursery ranged from $1.90 to $3.72 averaging $2.53. In the large nursery comparable costs were $1.50, $3.00, and $2.04. This approximate 25% gain in efficiency when going from the small to the large nursery is attributable to the more efficient use of buildings, machinery, and equipment of the large nursery over the small. Fixed costs as a percentage of total costs in the small nursery ranged from 42% to 51% averaging 46% across species. Comparable values for the large nursery were 37%, 46%, and 42%. Differences in fixed costs between plant species were totally determined by space requirements for production.

Variable costs per salable plant showed substantial differences between plant species, but were only slightly affected by size of nursery. In the small nursery they ranged from $2.60 to $3.64 averaging $2.93 across species. Comparable figures for the large nursery were $2.57, $3.60, and $2.88. Major differences between species affecting variable costs were spacing requirements, cost of liners and overwintering requirements. Variable costs between the two sized nurseries by species ranged from three to four cents per salable plant. Variable costs as a percentage of total costs in the small nursery ranged from 49% to 58% averaging 54%. Comparable values for the large nursery were 54%, 63% and 58%.

These figures demonstrated that variable costs per salable plant, while having wide variations between species, remain reasonably constant when comparisons are made between the two sized nurseries. The small nursery could purchase materials and other variable items almost as cheaply as could the large. Fixed costs in contrast changed significantly as size of nursery increased. This occurred because most of the fixed factors required to operate the small nursery such as management, buildings, and most machinery and equipment were

also adequate to operate the large. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing the fixed cost per plant.

Implications

A comparison of total annual costs of producing plants with prices in U.S.D.A. zone six producers' wholesale catalogs would undoubtedly show, in a great many cases, selling prices lower than total annual costs. In fact, if one were to add costs of selling, very few producers would presently be charging enough to cover all costs let alone profits. How then can producers continue to operate? The answer lies in how producers both experience and figure costs. We have used the economic or accounting method which includes both explicit and implicit costs. Explicit costs are those that are paid directly and easily determined, e.g. cost of liners, soil media, fertilizers, labor, etc. Implicit costs are those that are more difficult to determine such as the cost of equity capital and managerial capacities. The way these costs are determined vary significantly from firm to firm. Well established nurseries are usually very accurate in determining explicit costs, but often do not consider all implicit costs. They base their costs on "cash flow" and profit and loss on "tax accounting". These established nurseries, having purchased land at low cost, working with depreciated equipment and often assigning low if any value to their management would determine their costs at a much lower level than presented in this article. Also, as pointed out earlier, careful site selection could significantly reduce fixed (overhead) costs. However, if one were to start a new container nursery, in a "normal" U.S.D.A. climatic zone six site, costs would probably be very close to those presented here.

For the industry, selling nursery products for below "accounting costs" implys that well established nurseries, operating essentially debt free, would have strong staying power whereas those who have just started or are heavily in debt may not be able to survive, especially if they are relying on their container operation to meet all overhead expenses. Second, starting a container nursery in U.S.D.A. climatic zone six would probably not prove profitable unless items like buildings, equipment, machinery, management, etc., could be shared with other enterprises or unless selling prices of nursery products in the zone increasd substantially. At current prices for nursery products, this study shows that the return on investment for establishing new, independently operating, container nurseries in U.S.D.A. climatic zone six would be marginal if not negative.

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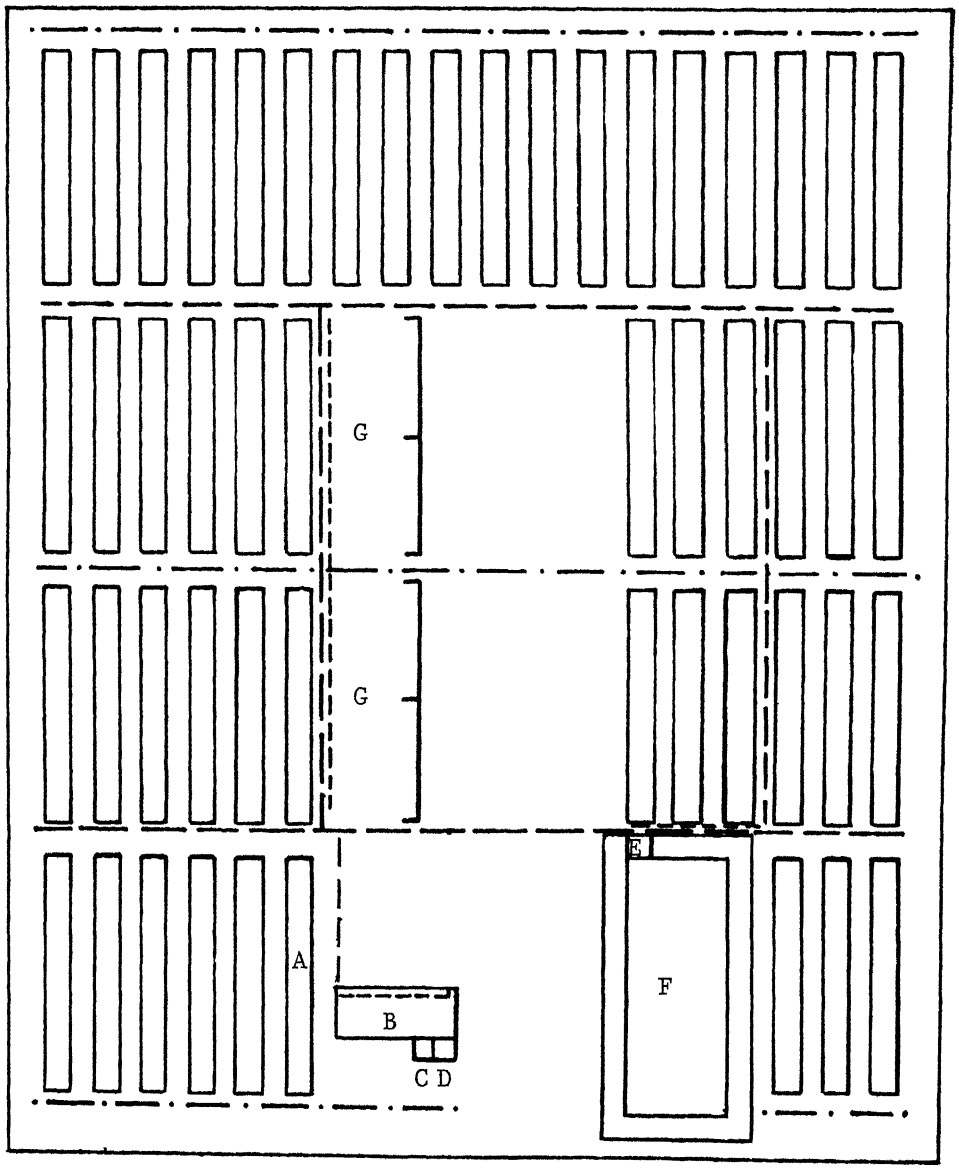
FIG. 1.--Schematic Drawing of a Small Commercial Container Nursery U.S.D.A. Climatic Zone Six.

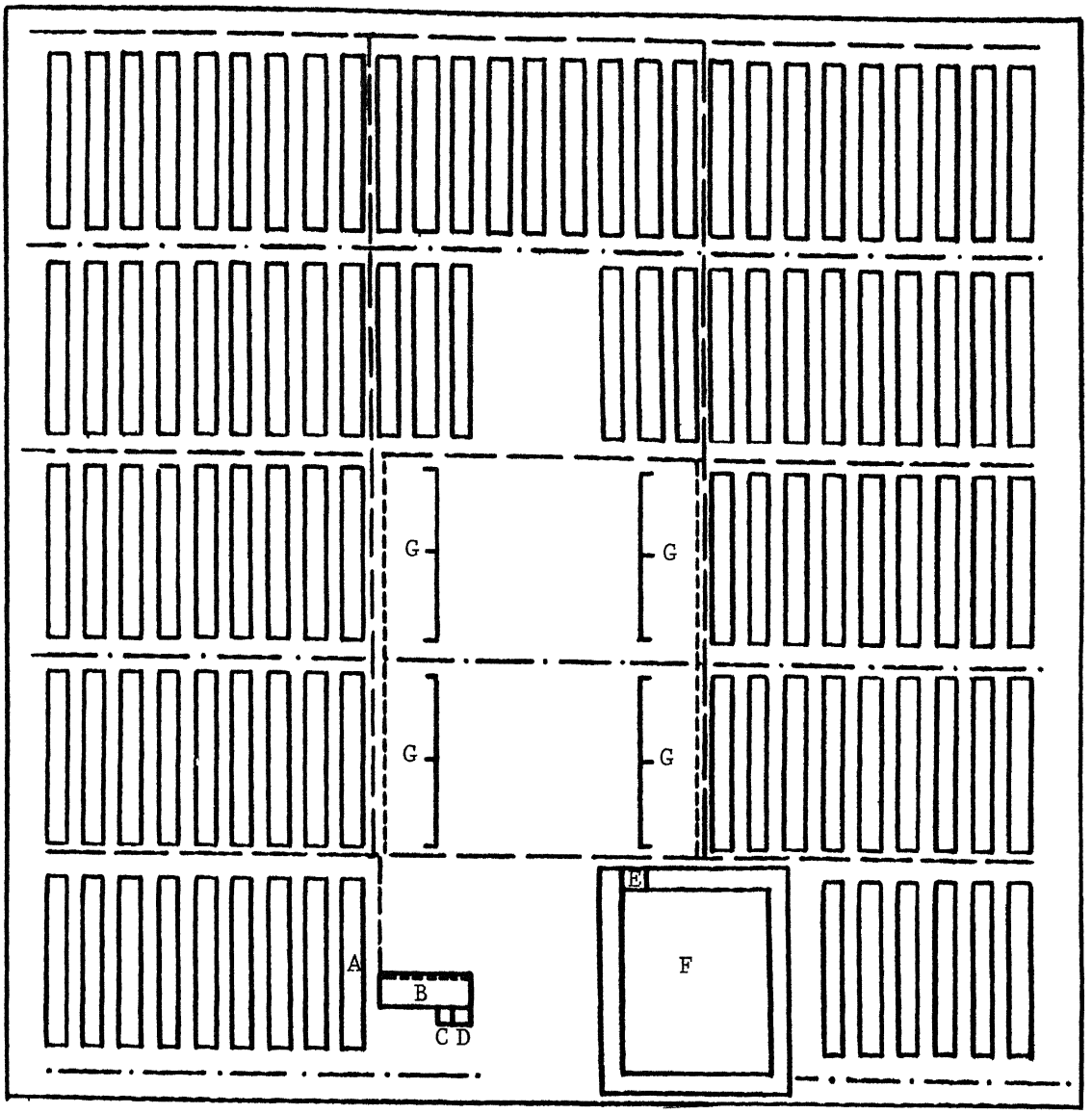


A. Polyhouse structure, 200' x 20'
B. Supply shed, machinery shed, machine shop, 40' x 100'
C. Office, 20' x 20'
D. Restrooms, 20' x 20'
E. Pump house, 10' x 10'
F. Pond, 80' x 120', 14' deep
G. Shipping area, 4 semi truckloads

Drainage Tile, 30" :
Watermain, 8" PVC :
Watermain, 6" PVC :
Watermain, 4" PVC :
Scale : 0 100 200

Total Acreage	= 765' x 970'	= 742,050 sq. ft.	= 17.04 acres
Total Polyhouse Acreage	= 51(20' x 200')	= 204,000 sq. ft.	= 4.68 acres
Total Growing Space	= 85(20' x 200')	= 340,000 sq. ft.	= 7.81 acres

FIG. 2.--Schematic Drawing of a Large Commerical Container Nurserv U.S.D.A. Climatic Zone Six.



A. Polyhouse structure, 200' x 20'
B. Supply shed, machinery storage, machinery shop, 40' x 100'
C. Office, 20' x 20'
D. Restrooms, 20' x 20'
E. Pump house, 10' x 10'
F. Pond, 160' x 220', 14' deep
G. Shipping area, 8 semi truckloads

Drainage Tile, 30":
Watermain, 8" PVC :
Watermain, 6" PVC :
Watermain, 4" PVC :
Scale: 0' 100' 200'

Total Acreage - 1230' x 1170' = 1,439,100 = 33.04 acres
Total Polyhouse Acreage - [102(20' x 200')] = 408,000 = 9.37 acres
Total Growing Space - [170(20' x 200')] = 680,000 = 15.61 acres

TABLE 1.--Capital Requirements for a Small* Commercial Container Nursery U.S.D.A. Climatic Zone Six, 1982

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	Acre		17.04	1,850	31,524	5
+ Improvements	Grading, tiling, graveling, pond		20			171,417	29
Subtotal						202,941	34
Buildings							
Office and restrooms	20′ x 40′ cement block	sq ft	20	800	28	22,400	4
Potting and packing shed	40′ x 50′ steel pole insulated	sq ft	20	2000	18	36,000	6
Machinery storage, shop	40′ x 50′ steel pole insulated	sq ft	20	2000	18	36,000	6
Polyhouse structures	200′ x 20′ pipe frame	each	10	51	2,193	111,843	19
Subtotal						206,243	35
Machinery and Equipment							
Tractor, 60 HP	60 HP, gas fuel with front end loader	each	10	1	16,000	16,000	3
Tractor, 28 HP	28 HP, gas fuel	each	10	2	6,025	12,050	2
Manure spreader	130 bu capacity	each	10	1	2,135	2,135	**
Wagon	4 wheel, self steering	each	10	2	2,300	4,600	1
Irrigation pump/well	75 HP electric pump	each	20	1	40,085	40,085	7
Inground irrigation system	PVC pipe/valves		20		38,801	38,801	7
Above ground irrigation system	PVC pipe/sprinklers		5		19,383	19,383	3
Fertilizer injector	200 gal	each	5	1	6,500	6,500	1
Airblast sprayer	300 gal, on trailer	each	7	1	6,955	6,955	1
Cyclone spreader	Hand operated	each		1	40	40	**
Forklift	3000 lb lift exterior wheels	each	10	1	24,000	24,000	4
Truck	1/2 ton pick-up	each	5	1	8,000	8,000	1
Pallets	Wooden	each	2	349	12	4,188	1
Handtools	Miscellaneous		5		1,000	1,000	**
Subtotal						183,737	31
TOTAL						592,921	100

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.
**Less than half of 1%.

TABLE 1a.--Capital Requirements for a Large* Commercial Container Nursery U.S.D.A. Climatic Zone Six, 1982

Item	Description	Unit	Useful Life (years)	Quantity	Cost per Unit (dollars)	Total Cost (dollars)	Percent of Total Cost
Land	Unimproved land	Acre		33.04	1,850	61,124	6
+ Improvements	Grading, tiling, graveling, pond		20			326,304	34
Subtotal						387,428	40
Buildings							
Office and restrooms	20′ x 40′ cement block	sq ft	20	800	28	22,400	2
Potting and packing shed	40′ x 50′ steel pole insulated	sq ft	20	2000	18	36,000	4
Machinery storage, shop	40′ x 50′ steel pole insulated	sq ft	20	2000	18	36,000	4
Polyhouse structures	200′ x 20′ pipe frame	each	10	102	2,193	223,708	23
Subtotal						318,108	33
Machinery and Equipment							
Tractor, 60 HP	60 HP, gas fuel with front end loader	each	10	1	16,000	16,000	2
Tractor, 28 HP	28 HP, gas fuel	each	10	2	6,025	12,050	1
Manure spreader	130 bu capacity	each	10	1	2,135	2,135	**
Wagon	4 wheel, self steering	each	10	4	2,300	9,200	1
Irrigation pump/well	75 HP electric pump	each	20	1	40,085	40,085	4
Inground irrigation system	PVC pipe/valves		20		77,160	77,160	8
Above ground irrigation system	PVC pipe/sprinklers		5		38,765	38,765	4
Fertilizer injector	200 gal	each	5	1	6,500	6,500	1
Airblast sprayer	300 gal, on trailer	each	7	1	6,955	6,955	1
Cyclone spreader	Hand operated	each		1	40	40	**
Forklift	3000 lb lift exterior wheels	each	10	1	24,000	24,000	2
Truck	1/2 ton pick-up	each	5	2	8,000	16,000	2
Pallets	Wooden	each	2	679	12	8,148	1
Handtools	Miscellaneous		5		2,000	2,000	**
Subtotal						259,038	27
TOTAL						964,574	100

*33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space.
**Less than half of 1%.

TABLE 2.--Land Improvement Costs for a Small and Large Container Nursery, U.S.D.A. Climatic Zone Six, 1982.

Item	Unit	Cost per Unit (dollars)	Small Container Nursery* Quantity (units)	Small Container Nursery* Total Cost (dollars)	Large Container Nursery** Quantity (units)	Large Container Nursery** Total Cost (dollars)
Grading						
Grading of land and pond top soil removal, 410.0 cu yd. per acre @ $0.85 per cu. yd.	acre	348.50	17.04	5,938	33.04	11,514
Grading including cutting and filling, 900 cu. yd. per acre @ $1.70 per cu. yd.	acre	1,530.00	17.04	26,071	33.04	50,551
Grading for pond				11,202		21,731
Subtotal				43,211		83,796
Tiling (water drainage)						
30" cement pipe @ $12.50/ft. Installation labor @ $8.60/ft.	foot	21.10	1,980	41,778	3,250	68,575
Subtotal				41,778		68,575
Graveling						
Production area within polyhouse structures, 20' x 200', 3" depth of #8 gravel = 37.04 cu. yd. per polyhouse or 37.04 ton @ $11.90/ton delivered and spread	polyhouse	440.78	51	22,480	102	44,960
Growing area between polyhouse structures, 4" depth of #4 gravel = 49.38 cu. yd. or 49.38 ton per 20' x 200' section @ $11.90/ton delivered and spread	20' x 200' section	587.62	34	19,979	68	39,958
Production area excluding grass, growing areas, pond - 4" depth of #4 gravel = 532.4 cu. yd. or 532.4 ton per acre @ $11.90 ton delivered and spread	acre	6,335.56	6.94	43,969	14.05	89,015
Subtotal				86,428		173,933
TOTAL				171,417		326,304

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space
**33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space

TABLE 3.--Cost of Polyhouse Construction for a Small and Large Container Nursery, U.S.D.A. Climatic Zone Six, 1982

Item	Cost per Item (dollars)	Cost per Polyhouse (dollars)	Small Container Nursery* Number of Polyhouses	Small Container Nursery* Total Cost (dollars)	Large Container Nursery** Number of Polyhouses	Large Container Nursery** Total Cost (dollars)
Polyhouse framework - 20′ x 200′						
Galvanized piping including all nuts, bolts, pipe	1,440.00	1,440.00	51	73,440	102	146,880
Wood - treated white pine						
1-5/4" x 8" x 440′ roughcut 3 graded or better	186.45					
4-2" x 4" x 8′ rough @ $2.49	9.96					
4-2" x 4" x 12′ rough @ $3.89	15.56					
4-1" x 6" x 8′ rough @ $1.85	7.40					
4-1" x 6" x 12′ rough @ $2.90	11.60					
5-2" x 2" x 8′ finished @ $1.45	7.25	238.22	51	12,149	102	24,298
Labor requirements						
100 hours	5.15***	515.00	51	26,265	102	52,530
TOTAL		2,193.22****		111,854		223,708

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.
**33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space.
***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.
****Approximately $0.55 per square foot.

TABLE 4. Cost of Irrigation System for a Small and Large Nursery, U.S.D.A. Climatic Zone Six, 1982

Item	Unit	Cost Per Unit (dollars)	Small Container Nursery* Quantity Needed	Small Container Nursery* Total Cost (dollars)	Large Container Nursery** Quantity Needed	Large Container Nursery** Total Cost (dollars)
Inground Irrigation System						
8" pipe, PVC	foot	3.81	2,330	8,877	4,930	18,783
6" pipe, PVC	foot	2.45	240	588	150	367
4" pipe, PVC	foot	1.37	2,230	3,055	4,300	6,480
2" pipe, PVC	foot	.48	570	274	1,116	536
Additional required equipment, estimated at 20% of pipe value				2,559		5,233
Installation charges						
for 6" and 8" pipe	foot	3.00	2,570	9,560	5,080	18,898
for 2" and 4" pipe	foot	4.96	2,800	13,888	5,416	26,863
Subtotal (inground irrigation system)				38,801		77,160
Above Ground Irrigation System						
1. Polyhouse structures 1-frost free hydrant 1" @ $44.75 200 ft of 1" PVC pipe @ $0.26/foot = $52.00 Installation labor/parts, estimated at 30% of pipe cost = $15.60 10-rotating sprinklers, rainbird 14-Vh series, 5/64" nozzels @ $9.60 = $96.00	polyhouse	208.35	51	10,626	102	21,252
2. Adjacent growing area to polyhouse 1-frost free hydrant, 1" @ $44.75 200-ft-1" PVC pipe @ $0.26/foot = $52.00 Installation labor/parts, estimated at 40% of pipe cost = $20.80 10-rotating sprinklers, Rainbird 14-Vh series, 5/64" nozzles @ $9.60 = $96.00 10-rises, couples stakes @ $4.40 = $44.00	200' x 20' growing spaces between polyhouses	257.55	34	8,757	102	17,513
Subtotal (above ground irrigation system)				19,383		38,765
TOTAL (Not including well and pump)				58,184		115,925
Cost of well				21,518		21,518
Cost of pump				18,567		18,567
TOTAL for irrigation system				98,269		156,010

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space
**33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space

TABLE 5. Specifications and Costs of Installing a 75 H.P. Electric Well Pump and an 80 Foot Well, U.S.D.A. Climatic Zone Six, 1982.

Specifications	Total Cost (dollars)
Pump - above ground, 75 HP* lineshaft, 18,000RPM	
Basic electric motor	3,024
Discharge head - 8" x 1" collar	904
Standard 10' length, inner column, 80' depth	1,006
Pipe and suction pipe	2,269
Pump bowl assembly -3 stage, 12" pump	2,071
Air line guage	70
Well seal, well plate, cement	646
Electrical equipment	807
Installation fee	807
Right angle geaar drive, auxillary power source using a tractor	2,830
Subtotal	14,434
+ Freight @ 10%	1,443
+ Building	2,690
Total cost for pump, including shelter	18,567
Well Drilling	
Casting diameter, 16" O.D.	21,518
Total cost for well	21,518
TOTAL	40,085

*A 75 H.P. pump can supply 900 gallons per minute of water at 65 psi given the specifications and site location.

TABLE 6.--Capacity in Number of Plants and Capital Required per Salable Plant Capacity by Spacing for a Small* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Group	Growing Cycle Spacing				Production factors		
	Growing Season On-center (inch)	First Year Over-Wintering (inch)	Second Growing Season On-center (inch)	Second Year Over-Wintering (inch)	Total Plants in Production (units)	Salable Plants per Year (units)	Capital Requirements per Salable Plant Capacity (dollars)
I - Juniperus	9	9	15	12	53,120	25,600	4.63
II - Cotoneaster	12	9	15	15	43,095	20,730	5.72
III - Taxus	9	9	18	15	41,750	20,085	5.90
IV - Viburnum	12	12	21	15	33,655	16,185	7.33
V - Rhododendron	12	12	18	18	27,125	13,050	9.09
Totals					198,745	95,650	6.20

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space. Each group of plants would occupy 20 percent of the growing (60,000 sq ft) and polyhouse (40,800 sq ft) space.

TABLE 6a.--Capacity in Number of Plants and Capital Required per Salable Plant Capacity by Spacing for a Large* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Group	Growing Cycle Spacing				Production factors		
	Growing Season On-center (inch)	First Year Over-Wintering (inch)	Second Growing Season On-center (inch)	Second Year Over-Wintering (inch)	Total Plants in Production (units)	Salable Plants per Year (units)	Capital Requirements per Salable Plant Capacity (dollars)
I - Juniperus	9	9	15	12	107,900	52,000	3.71
II - Cotoneaster	12	9	15	15	86,180	41,455	4.65
III - Taxus	9	9	18	15	83,505	40,165	4.80
IV - Viburnum	12	12	21	15	67,320	32,380	5.96
V - Rhododendron	12	12	18	18	54,255	26,095	7.39
Totals					399,160	192,095	5.02

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space. Each group of plants would occupy 20 percent of the growing (136,000 sq ft) and polyhouse (81,600 sq ft) space.

TABLE 7. Annual Fixed Costs (Dollars) for a Small* Container Nursery U.S.D.A. Climatic Zone Six, 1982

Item	Description	Depreciation**	Interest***	Insurance and Taxes	Total
Land	Unimproved land		4,739	631	5,370
+ Improvements	Grading, tiling, graveling, pond	8,571	25,713	3,428	37,712
Subtotal		8,571	30,452	4,059	43,082
Buildings					
Office and restrooms	20′ x 40′	1,120	3,360	568	5,048
Potting and packing shed	40′ x 50′	1,800	5,400	913	8,113
Machinery storage and shop	40′ x 50′	1,800	5,400	913	8,113
Polyhouse structures	200′ x 20′	10,066	16,777	2,835	29,678
Subtotal		14,786	30,937	5,229	50,952
Machinery and Equipment					
Tractor, 60 HP	60 HP, gas fuel w/front-end loader	1,440	2,400	73	3,913
Tractor, 28 HP	28 HP, gas fuel	1,085	1,808	55	2,948
Manure spreader	130 bu capacity	192	320	10	522
Wagon	4-wheel	414	690	21	1,125
Irrigation pump/well	75 HP, electric pump	1,804	6,013	182	7,999
Inground irrigation system	PVC pipe/sprinklers	1,940	5,820	176	7,936
Above ground irrigation system	PVC pipe/sprinklers	3,489	2,908	88	6,485
Fertilizer injector	200 gal injector	1,170	975	30	2,175
Airblast sprayer	300 gal, on trailer	894	1,043	36	1,973
Forklift	3,000 lb lift, exterior-use wheels	2,160	3,600	109	5,869
Truck	1/2 ton pickup	1,440	1,200	36	2,676
Pallets	Wooden	1,047	628		1,675
Handtools	Miscellaneous	200	150		350
Subtotal		17,275	27,555	816	45,646
General Overhead					
Utilities	Telephone, electric, gas heat				5,325
Licenses and bonds					375
General repairs and maintenance	Buildings, grounds				6,140
Advertising and printing					1,050
Insurance, personnel	Workmen's comp., FICA, health, unemp.				19,060
Travel and other					1,500
Professional fees					75
Administrative and Management	Clerical, operator, supervisory, labor and office supplies				60,500
Miscellaneous					1,000
Subtotal					95,025
Interest on General Overhead, Insurance, and Taxes	Compounded at 15% per annum for 6 months				7,885
Total Annual Fixed Costs					242,590

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.
**Depreciation was estimated by dividing initial cost adjusted for salvage value, by the years of useful life.
***Interest costs were estimated by multiplying the initial value of land, building, equipment and machinery by the interest rate, 15% per annum.

TABLE 7a. Annual Fixed Costs (Dollars) for a Large* Container Nursery U.S.D.A. Climatic Zone Six, 1982

Item	Description	Depreciation**	Interest***	Insurance and Taxes	Total
Land	Unimproved land		9,169	1,223	10,392
+ Improvements	Grading, tiling, graveling, pond	16,315	48,946	6,526	71,787
Subtotal		16,315	58,115	7,749	82,179
Buildings					
Office and restrooms	20′ x 40′	1,120	3,360	568	5,048
Potting and packing shed	40′ x 50′	1,800	5,400	913	8,113
Machinery storage and shop	40′ x 50′	1,800	5,400	913	8,113
Polyhouse structures	200′ x 20′	20,134	33,556	5,671	59,361
Subtotal		24,854	47,716	8,065	80,635
Machinery and Equipment					
Tractor, 60 HP	60 HP, gas fuel w/front-end loader	1,440	2,400	73	3,913
Tractor, 28 HP	28 HP, gas fuel	1,085	1,808	55	2,948
Manure spreader	130 bu capacity	192	320	10	522
Wagon	4-wheel	828	1,380	42	2,250
Irrigation pump/well	75 HP, electric pump	1,804	6,013	182	7,999
Inground irrigation system	PVC pipe/sprinklers	3,858	11,574	350	15,782
Above ground irrigation system	PVC pipe/sprinklers	6,978	5,815	176	12,969
Fertilizer injector	200 gal injector	1,170	975	30	2,175
Airblast sprayer	300 gal, on trailer	894	1,043	36	1,973
Forklift	3,000 lb lift, exterior-use wheels	2,160	3,600	109	5,869
Truck	1/2 ton pickup	2,880	2,400	73	5,353
Pallets	Wooden	2,037	1,222		3,259
Handtools	Miscellaneous	400	300		700
Subtotal		25,726	38,850	1,136	65,712
General Overhead					
Utilities	Telephone, electric, gas heat				7,990
Licenses and bonds					565
General repairs and maintenance	Buildings, grounds				10,585
Advertising and printing					1,575
Insurance, personnel	Workmen's comp., FICA, health, unemp.				31,420
Travel and other					2,250
Professional fees					115
Administrative and managemeent	Clerical, operator, supervisory, labor and office supplies				93,500
Miscellaneous					2,000
Subtotal					150,000
Interest on General Overhead, Insurance, and Taxes	Compounded at 15% per annum for 6 months				12,521
Total Annual Fixed Costs					391,047

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.
**Depreciation was estimated by dividing initial cost adjusted for salvage value, by the years of useful life.
***Interest costs were estimated by multiplying the initial value of land, building, equipment and machinery by the interest rate, 15% per annum.

TABLE 8.--Annual Variable Costs (Dollars) for Group I Plants (Juniperus) for a Small* Container Nursery in U.S.D.A Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	26,885.00	7,797
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	215.20	6,671
Liners	2-year 6-7" liner	each	.95	26,885.00	25,541
Polyethylene film	4 mil white, 32' x 225'	each	107.00	10.20	1,091
Strip tags	5/8" x 7" plastic strip tag	each	.02	25,600.00	512
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	1.50	33
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	60.20	114
	Osmocote 8-9 mo (18-6-12)	pound	.86	3,631.60	3,123
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (Roundup) (herbicide)	quart	16.60	2.80	47
Subtotal					45,631
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15**	2,044.00	10,527
	Related labor hours	hour	5.15	409.00	2,106
Subtotal					12,633
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	61,875.00	4,641
Total Annual Variable Costs					66,580
Annual Variable Cost per 12-15 Inch Salable Plant					2.60

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Group I Plants - 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 25,600 12-15 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 8a.--Annual Variable Costs (Dollars) for Group I Plants (Juniperus) for a Larger Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	54,635.00	15,844
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	437.00	13,547
Liners	2-year 6-7" liner	each	.95	54,635.00	51,903
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Strip tags	5/8" x 7" plastic strip tag	each	.02	52,000.00	1,040
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Osmocote 8-9 mo (18-6-12)	pound	.86	7,376.60	6,344
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (Roundup) (herbicide)	quart	16.60	5.60	93
Subtotal					92,649
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15**	4,045.00	20,832
	Related labor hours	hour	5.15	809.00	4,166
Subtotal					24,998
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	123,795.00	9,285
Total Annual Variable Costs					133,214
Annual Variable Cost per 12-15 Inch Salable Plant					2.56

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Group I Plants - 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 52,000 12-15 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 9.--Annual Variable Costs (Dollars) for Group II Plants (Cotoneaster) for a Small* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	21,820.00	6,328
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	174.56	5,411
Liners	2-year 6-7" liner	each	.85	21,820.00	18,547
Polyethylene film	4 mil white, 32' x 225'	each	107.00	10.20	1,091
Thermal blanket	4 - 1/4" 80" x 225' per house	each	775.00	1/3 (10.20)**	2,635
Strip tags	5/8" x 7" plastic strip tag	each	.02	20,730.00	415
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Metra-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	1.50	33
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	60.20	114
	Osmocote 8-9 mo (18-6-12)	pound	.86	3,425.58	2,946
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (Roundup) (herbicide)	quart	16.60	2.80	46
Subtotal					38,268
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15***	1,622.00	8,353
	Related labor hours	hour	5.15	324.40	1,671
Subtotal					10,024
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	53,868.00	4,040
Total Annual Variable Costs					56,007
Annual Variable Cost per 12-15 Inch Salable Plant					2.70

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Group II Plants - 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 20,730 12-15 inch salable plants per year.

**Thermal blankets would be used for three seasons.

***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 9a.--Annual Variable Costs (Dollars) for Group II Plants (Cotoneaster) for a Large* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	46,635.00	12,654
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	347.08	10,760
Liners	2-year 6-7" liner	each	.85	43,635.00	31,090
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Thermal blanket	4 - 1/4" 80" x 225' per house	each	775.00	1/3 (20.40)**	5,270
Strip tags	5/8" x 7" plastic strip tag	each	.02	41,455.00	829
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Osmocote 8-9 mo (18-6-12)	pound	.86	6,850.00	5,891
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (herbicide)	quart	16.60	5.90	93
Subtotal					76,465
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15***	3,245.00	16,712
	Related labor hours	hour	5.15	649.00	3,342
Subtotal					20,054
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	106,597.00	7,995
Total Annual Variable Costs					110,796
Annual Variable Cost per 12-15 Inch Salable Plant					2.67

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Group II Plants - 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 41,455 12-15 inch salable plants per year.

**Thermal blankets would be used for three seasons.

***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 10.--Annual Variable Costs (Dollars) for Group III Plants (Taxus) for a Small* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	21,140.00	6,131
Soil mixture	Pine bark, sand, nutrients	cu yd	33.00	169.20	5,584
Liners	3-year 6-7" liner	each	1.25	21,140.00	26,425
Polyethylene film	4 mil white, 32' x 225'	each	107.00	10.20	1,091
Strip tags	5/8" x 7" plastic strip tag	each	.02	20,085.00	402
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Metra-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	1.50	33
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	60.20	114
	Lesco 3-4 mo (20-6-12)+Fe	pound	.80	5,707.80	4,566
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (Roundup) (herbicide)	quart	16.60	2.80	47
Subtotal					45,095
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15**	1,673.00	8,616
	Related labor hours	hour	5.15	335.00	1,725
Subtotal					10,341
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	58,996.00	4,425
Total Annual Variable Costs					63,536
Annual Variable Cost per 12-15 Inch Salable Plant					3.16

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Group III Plants - 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 20,085 12-15 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 10a.--Annual Variable Costs (Dollars) for Group III Plants (Taxus) for a Large* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	42,280.00	12,261
Soil mixture	Pine bark, sand, nutrients	cu yd	33.00	338.40	11,168
Liners	3-year 6-7" liner	each	1.25	42,280.00	52,850
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Strip tags	5/8" x 7" plastic strip tag	each	.02	40,165.00	803
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Lesco 3-4 mo (20-6-12)	pound	.80	11,415.60	9,132
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (Roundup) (herbicide)	quart	16.60	5.60	93
Subtotal					90,185
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15**	3,346.00	17,231
	Related labor hours	hour	5.15	669.00	3,445
Subtotal					20,676
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	117,009.00	8,776
Total Annual Variable Costs					125,919
Annual Variable Cost per 12-15 Inch Salable Plant					3.14

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Group III Plants - 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 40,165 12-15 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 11.--Annual Variable Costs (Dollars) for Group IV Plants (Viburnum) for a Small* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	17,040.00	4,942
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	136.32	4,226
Liners	2-year 6-7" liner	each	1.00	17,040.00	17,040
Polyethylene film	4 mil white, 32' x 225'	each	107.00	10.20	1,091
Strip tags	5/8" x 7" plastic strip tag	each	.02	16,185.00	324
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Metra-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	1.50	33
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	60.20	114
	Osmocote 8-9 mo (18-6-12)	pound	.86	2,674.42	2,300
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (Roundup) (herbicide)	quart	16.60	2.80	46
Subtotal					30,818
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15**	1,348.00	6,942
	Related labor hours	hour	5.15	270.00	1,391
Subtotal					8,333
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	42,762.00	3,207
Total Annual Variable Costs					46,033
Annual Variable Cost per 18-24 Inch Salable Plant					2.84

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Group IV Plants - 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 16,185 18-24 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 11a.--Annual Variable Costs (Dollars) for Group IV Plants (Viburnum) for a Larger* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	34,085.00	9,885
Soil mixture	Hardwood bark, sand, nutrients	cu yd	31.00	272.68	8,453
Liners	2-year 6-7" liner	each	1.00	34,085.00	34,085
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Strip tags	5/8" x 7" plastic strip tag	each	.02	32,380.00	648
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Osmocote 8-9 mo (18-6-12)	pound	.86	5,351.16	4,602
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (Roundup) (herbicide)	quart	16.60	5.60	93
Subtotal					61,644
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15**	2,695.00	13,879
	Related labor hours	hour	5.15	539.00	2,776
Subtotal					16,655
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	84,447.00	6,334
Total Annual Variable Costs					90,915
Annual Variable Cost per 18-24 Inch Salable Plant					2.81

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Group IV Plants - 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 32,380 18-24 inch salable plants per year.

**Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 12.--Annual Variable Costs (Dollars) for Group V Plants (Rhododendron) for a Small* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	13,735.00	3,983
Soil mixture	Pine bark, sand, nutrients	cu yd	33.00	110.00	3,630
Liners	2-year 6-7" liner	each	1.25	13,735.00	17,169
Polyethylene film	4 mil white, 32' x 225'	each	107.00	10.20	1,091
Thermal blanket	4 - 1/4" 80" x 225' per house	each	775.00	1/3 (10.20)**	2,635
Strip tags	5/8" x 7" plastic strip tag	each	.02	13,050.00	261
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	292.00	263
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	6.00	60
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	52.00	37
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	1.50	33
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	60.20	114
	Lesco 3-4 mo (20-6-12)	pound	.80	4,311.62	3,449
	Urea 45-0-0 (fertilizer)	pound	.13	2,628.40	342
	Glyphosate (herbicide)	quart	16.60	2.80	46
Subtotal					33,113
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	26.60	422
	Tractor, 28 HP	hour	4.92	103.40	509
	Manure spreader, 130 bu	hour	1.58	8.60	14
	Wagon, 4-wheel	hour	0.53	155.60	82
	Irrigation/well, pump 75 HP	hour	6.65	147.00	978
	Inground irrigation system	hour	1.54	147.00	226
	Above ground irrigation system	hour	3.09	147.00	454
	Fertilizer injector	hour	4.33	24.00	104
	Airblast sprayer	hour	23.98	3.20	77
	Forklift	hour	6.59	26.00	171
	1/2 ton pick-up truck	hour	8.51	75.00	638
Subtotal					3,675
Labor					
	Labor hours	hour	5.15***	1,176.00	6,056
	Related labor hours	hour	5.15	235.00	1,210
Subtotal					7,266
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	45,956.00	3,447
Total Annual Variable Costs					47,501
Annual Variable Cost per 15-18 Inch Salable Plant					3.64

*Total Nursery - 17.04 acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space.
Group V Plants - 68,000 sq ft of growing space, 40,800 sq ft of polyhouse space, 13,050 15-18 inch salable plants per year.

**Thermal blankets would be used for three seasons.

***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 12a.--Annual Variable Costs (Dollars) for Group V Plants (Rhododendron) for a Large* Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Description	Unit	Cost per Unit	Quantity	Total Variable Cost
Materials					
Container	#2, 8 1/2" x 8" copolymer propylene	each	0.29	27,470.00	7,966
Soil mixture	Pine bark, sand, nutrients	cu yd	33.00	220.08	7,260
Liners	2-year 6-7" liner	each	1.25	27,470.00	34,338
Polyethylene film	4 mil white, 32' x 225'	each	107.00	20.40	2,183
Thermal blanket	4 - 1/4" 80" x 225' per house	each	775.00	1/3 (20.40)**	5,270
Strip tags	5/8" x 7" plastic strip tag	each	.02	26,095.00	522
Chemicals	Oxadiazon 4G (Ronstar) (herbicide)	pound	.90	597.00	537
	Benomyl 50 WP (Benlate) (fungicide)	pound	10.00	12.40	124
	Demetron 6 (Meta-Systox-M) (insecticide)	ounces	.71	106.00	75
	Cyhexatin 50WP (Kelthane) (miticide)	pound	22.25	3.20	71
	Chlorothalonil 10M cu ft (Termil) (fungicide)	canister	1.90	122.00	232
	Lesco 3-4 mo (20-6-12)	pound	.80	8,623.20	6,899
	Urea 45-0-0 (fertilizer)	pound	.13	5,043.40	656
	Glyphosate (Roundup) (herbicide)	quart	16.60	5.90	93
Subtotal					66,226
Machinery and Equipment					
	Tractor, 60 HP	hour	15.85	54.00	856
	Tractor, 28 HP	hour	4.92	210.00	1,033
	Manure spreader, 130 bu	hour	1.58	17.40	27
	Wagon, 4-wheel	hour	0.53	316.00	167
	Irrigation/well, pump 75 HP	hour	6.65	200.40	1,333
	Inground irrigation system	hour	1.54	200.40	309
	Above ground irrigation system	hour	3.09	200.40	619
	Fertilizer injector	hour	4.33	36.00	156
	Airblast sprayer	hour	23.98	6.60	158
	Forklift	hour	6.59	52.80	348
	1/2 ton pick-up truck	hour	8.51	150.00	1,276
Subtotal					6,282
Labor					
	Labor hours	hour	5.15***	2,350.00	12,103
	Related labor hours	hour	5.15	470.00	2,421
Subtotal					14,524
Interest Charge on Operating Capital	Computed at 15% on an annual basis for 6 months	percent	7.5 (0.075)	90,828.00	6,812
Total Annual Variable Costs					93,844
Annual Variable Cost per 15-18 Inch Salable Plant					3.60

*Total Nursery - 33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space.
Group V Plants - 136,000 sq ft of growing space, 81,600 sq ft of polyhouse space, 26,095 15-18 inch salable plants per year.

**Thermal blankets would be used for three seasons.

***Average basic wage before withholding taxes and fringes $4.30, taxes and fringes add 19.84% or $0.85 for a total of $5.15.

TABLE 13.--Estimated Variable Cost per Hour of Use for Machinery and Equipment for Container Nurseries, U.S.D.A. Climatic Zone Six, 1982

Item Number	Item	New Cost (dollars)	Expected Life (years)	Estimated Annual Use: Small* Nursery (hours)	Estimated Annual Use: Large** Nursery (hours)	Estimated Cost per Hour of Use: Repairs*** (dollars)	Fuel**** (dollars)	Lubrication and Filter (dollars)	Total (dollars)
1	Tractor, 60 HP, front end loader	16,000	10	132.70	269.50	5.34	9.14	1.37	15.85
2	Tractor, 28 HP	6,025	10	258.35 ea	349.92 ea	1.55	2.93	0.44	4.92
3	Manure spreader, 130 bu.	2,135	10	43.00	87.40	1.58			1.58
4	Wagon, 4-wheel, self steer	2,300	10	259.23 ea	263.25 ea	0.53			0.53
5	Irrigation well & Pump-75 HP	40,085	20	735.00	1,002.50	0.20	5.61	0.84	6.65
6	Inground irrigation system*****	77,160	20	735.00	1,002.50	1.54			1.54
7	Above ground irrigation system*****	38,765	5	735.00	1,002.50	3.09			3.09
8	Fertilizer injector	6,500	5	120.00	180.00	4.33			4.33
9	Air blast sprayer	6,995	7	16.20	33.15	23.98			23.98
10	Cyclone spreader	40	-	12.40	25.40				
11	Forklift	24,000	10	129.84	264.00	5.45	0.99	0.15	6.59
12	Truck, 1/2 ton pick-up	8,000	5	375.00	375.00 ea	3.84	4.06	0.61	8.51

*17.04 acres, 340,000 sq ft growing space, 204,000 sq ft of polyhouse space.

**33.04 acres, 680,000 sq ft growing space, 408,000 sq ft of polyhouse space.

***Repairs per hour were based on useage of the large nursery. They were computed on the basis of percent of new cost over the life of the asset. Percent factors used were: 90 for item numbers 1,2,and 12; 80 for item 9; 65 for item 3; 60 for items 4, 8, and 11; 40 for items 6 and 7; and 10 for item 5. The total was then divided by the estimated total number of hours the equipment would be used in the large nursery during the life of the asset.

****Fuel was estimated at $1.27 gallon for gasoline drived items, $0.27 per killowatt for electrical driven and $24.66 for L.P. tank gas.

*****Cost is for a large nursery on which variable costs per hour were based. Cost for the small nursery was lower.

TABLE 14.--Summary of Annual Fixed, Variable and Total Costs (Dollars) of Operating a Small* Container Nursery in U.S.D.A. Climatic Zone Six, 1982

Item	Group I (Juniper)	Group II (Contoneaster)	Group III (Taxus)	Group IV (Viburnum)	Group V (Rhododendron)	Total
Fixed Cost						
Land and improvements	8,616	8,616	8,616	8,616	8,616	43,080
Buildings	10,190	10,190	10,190	10,190	10,190	50,950
Machinery and equipment	9,129	9,129	9,129	9,129	9,129	45,645
General overhead	19,005	19,005	19,005	19,005	19,005	95,025
Interest on general overhead, isurance, and taxes	1,577	1,577	1,577	1,577	1,577	7,885
Subtotal	48,517	48,517	48,517	48,517	48,517	242,585
Variable Costs						
Materials	45,631	38,268	45,095	30,818	33,113	192,925
Machinery and equipment	3,675	3,675	3,675	3,675	3,675	18,375
Labor	12,633	10,024	10,341	8,333	7,266	48,597
Interest on operating capital	4,641	4,040	4,425	3,207	3,447	19,760
Subtotal	66,580	56,007	63,536	46,033	47,501	279,657
TOTAL	115,097	104,524	112,053	94,550	96,018	522,242
Salable Plants per Year	25,600	20,730	20,085	16,185	13,050	95,650
Annual Cost per Salable Plant	4.50	5.04	5.58	5.84	7.36	5.46

*17.04 Acres, 340,000 sq ft of growing space, 204,000 sq ft of polyhouse space

TABLE 14a.--Summary of Annual Fixed, Variable and Total Costs (Dollars) of Operating a Larger Container Nursery in U.S.D.A. Climatic Zone Six, 1982

Item	Group I (Juniper)	Group II (Contoneaster)	Group III (Taxus)	Group IV (Viburnum)	Group V (Rhododendron)	Total
Fixed Cost						
Land and improvements	16,436	16,436	16,436	16,436	16,436	82,180
Buildings	16,127	16,127	16,127	16,127	16,127	80,635
Machinery and equipment	13,142	13,142	13,142	13,142	13,142	65,710
General overhead	30,000	30,000	30,000	30,000	30,000	150,000
Interest on general overhead, insurance, and taxes	2,504	2,504	2,504	2,405	2,504	12,520
Subtotal	78,209	78,209	78,209	78,209	78,209	391,045
Variable Costs						
Materials	92,649	76,465	90,185	61,644	66,226	387,169
Machinery and equipment	6,282	6,282	6,282	6,282	6,282	31,410
Labor	24,998	20,054	20,676	16,655	14,524	96,907
Interest on operating capital	9,285	7,995	8,776	6,334	6,812	39,202
Subtotal	133,214	110,796	125,919	90,915	93,844	554,688
TOTAL	211,423	189,005	204,128	169,124	172,053	945,733
Salable Plants per Year	52,000	41,455	40,165	32,380	26,095	192,095
Annual Cost per Salable Plant	4.07	4.56	5.08	5.22	6.59	4.92

*33.04 acres, 680,000 sq ft of growing space, 408,000 sq ft of polyhouse space

TABLE 15.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) per Salable Plant of Operating a Small Container Nursery in U.S.D.A. Climatic Zone Six, 1982.

Item	Group I (Juniper)		Group II (Cotoneaster)		Group III (Taxus)		Group IV (Viburnum)		Group V (Rhododendron)		Average	
	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	.34	(8)	.41	(8)	.43	(8)	.53	(9)	.66	(9)	.45	(8)
Buildings	.40	(9)	.49	(10)	.51	(9)	.63	(11)	.78	(11)	.53	(10)
Machinery and Equipment	.36	(8)	.44	(8)	.45	(8)	.56	(9)	.70	(9)	.48	(9)
General Overhead	.74	(16)	.92	(18)	.95	(17)	1.18	(20)	1.46	(20)	.99	(18)
Interest on General Overhead, Insurance, and Taxes	.06	(1)	.08	(2)	.08	(1)	.10	(2)	.12	(2)	.08	(1)
Subtotal	1.90	(42)	2.34	(46)	2.42	(43)	3.00	(51)	3.72	(51)	2.53	(46)
Variable Cost Items												
Materials	1.78	(40)	1.85	(37)	2.24	(40)	1.90	(33)	2.54	(35)	2.02	(37)
Machinery and Equipment	.15	(3)	.18	(4)	.18	(3)	.23	(4)	.28	(4)	.19	(4)
Labor	.49	(11)	.48	(9)	.52	(10)	.51	(9)	.56	(7)	.51	(9)
Interest on Operating Capital	.18	(4)	.19	(4)	.22	(4)	.20	(3)	.26	(3)	.21	(4)
Subtotal	2.60	(58)	2.70	(54)	3.16	(57)	2.84	(49)	3.64	(49)	2.93	(54)
Total Annual costs	4.50	(100)	5.04	(100)	5.58	(100)	5.84	(100)	7.36	(100)	5.46	(100)

*17.04 acres, 340,000 sq ft of growing space , 204,000 sq ft of polyhouse space

TABLE 15a.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) per Salable Plant of Operating a Large Container Nursery in U.S.D.A. Climatic Zone Six, 1982

Item	Group I (Juniper)		Group II (Cotoneaster)		Group III (Taxus)		Group IV (Viburnum)		Group V (Rhododendron)		Average	
	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost	Cost per Saleable Plant	Percent of Total Cost
Fixed Cost Items												
Land and Improvements	.31	(8)	.40	(9)	.41	(8)	.51	(10)	.63	(10)	.43	(9)
Buildings	.31	(8)	.39	(9)	.40	(8)	.50	(9)	.62	(9)	.42	(9)
Machinery and Equipment	.25	(6)	.32	(7)	.33	(6)	.41	(8)	.50	(8)	.34	(7)
General Overhead	.58	(14)	.72	(16)	.75	(15)	.92	(18)	1.15	(17)	.78	(16)
Interest on General Overhead, Insurance, and Taxes	.05	(1)	.06	(1)	.06	(1)	.08	(1)	.10	(2)	.07	(1)
Subtotal	1.50	(37)	1.89	(42)	1.95	(38)	2.42	(46)	3.00	(46)	2.04	(42)
Variable Cost Items												
Materials	1.79	(44)	1.85	(41)	2.24	(44)	1.90	(36)	2.54	(39)	2.01	(41)
Machinery and Equipment	.12	(3)	.15	(3)	.16	(3)	.19	(4)	.24	(3)	.16	(3)
Labor	.48	(12)	.48	(10)	.51	(10)	.51	(10)	.56	(8)	.51	(10)
Interest on Operating Capital	.18	(4)	.19	(4)	.22	(5)	.20	(4)	.26	(4)	.20	(4)
Subtotal	2.57	(63)	2.67	(58)	3.13	(62)	2.80	(54)	3.60	(54)	2.88	(58)
Total Annual costs	4.07	(100)	4.56	(100)	5.08	(100)	5.22	(100)	6.59	(100)	4.92	(100)

*33.04 acres, 680,000 sq ft of growing space , 408,000 sq ft of polyhouse space.

APPENDIX

Production Cycle for Container Grown Plants - Two Years in Nursery

Group one - Juniperus - 12-15 inch saleable plant
Group two - Cotoneaster - 12-15 inch saleable plant
Group three - Taxus - 12-15 inch saleable plant
Group four - Viburnum - 18-24 inch saleable plant
Group five - Rhododendron - 15-18 inch saleable plant

March of the First Production Year

1. Growing media is premixed. Media is composed of five parts bark and one part coarse sand. For Juniperus, Cotoneaster, and Viburnum composted hardwood bark is used while for Taxus and Rhododendron pinebark is used. The material would be mixed in a 130 bushel capacity manure spreader.

May of the First Production Year

1. Growing area cleared of unsaleable stock. This requires a tractor with attached wagon.
2. Regrading of gravel, where needed, inside the polyhouse framework.
3. Purchased 6-7 inch liners are stored in a cool part of the storage shed until potting operations begin. Juniperus, Coton-easter, Viburnum, and Rhododendron are two year old liners while the Taxus are three years old. Due to lack of refrigerated storage, liners should be received as close to potting time as possible.
4. Liners would be root pruned, using hand shears, to remove any damaged or dead roots which would interfere with the healthy regeneration of a root system in the container.
5. Top growth that is not in proportion to the root system is trimmed.
6. Two gallon (8 1/2" X 8") containers are filled by hand at the site where the plants are to be placed in the polyhouse framework.
7. Plants are potted. A four wheel wagon is used as a potting bench. Growing media is transferred to the potting bench using a front end loader attached to a tractor.
8. Each plant is fertilized with 1-1/2 tablespoons of slow release fertilizer. Groups 1, 2, and 3 (Juniperus, Cotoneaster, and Viburnum) use Osmocote

18-6-12, nine month while groups 4 and 5 (Taxus and Rhododendron) use Lesco 20-6-12 + Fe, 3-4 month.

9. Containers are then placed in the polyhouse structure. Groups 1, 2, and 3 (Pfitzer Juniper, Taxus and Rhododendron) are placed can-to-can while groups 2 and 4 (Cotoneaster and Viburnum) are spaced 12 inch-on-center. A cleared two foot pathway is left down the center of the polyhouse.

   Note: A seven man team can pot, fertilize and place approximately 455 two gallon containers per hour (65/man/hour).

May-September of the First Production Year

1. Irrigation system will be used approximately 50 times. Exact number and frequency of irrigations will depend upon weather conditions. Three-tenths of the total irrigation time and labor hours are allocated to the first year's production. This is based on the amount of growing space the crop occupies, which is less the first year compared to the second.
2. Supplemental fertilizer, For all five groups, is applied through the irrigation system approximately once a week at 200 ppm Nitrogen (using Urea fertilizer, 45-0-0). Groups 4 and 5 (Taxus and Rhododendron) are additionally fertilized using a slow release feeding of granular Lesco 20-6-12 + Fe. The plants are irrigated for one hour, then the soluble fertilizer is injected into the irrigation system for three hours, and finally plain water used for one hour to wash fertilizer off the foilage of the plants and to keep the sprinkler nozzles from clogging with chemical deposits.
3. Insecticides/fungicides are applied six times during the first growing season. Rates per application were 15 ounces of Benomyl 50 WP per acre as fungicide, eight ounces of Demetron six per acre for insect control and four ounces of Cyhexatin 50 WP per acre for mite control. These materials are applied utilizing an air blast sprayer run by the power takeoff of the pulling tractor.
4. Plants are hand weeded. With a well managed herbicide program, hand weeding is held to a minimum and approximately 600 two gallon containers can be weeded per hour per individual.
5. A light pruning is required to remove excessive growth and to induce a compact, well-branched plant.
6. Herbicide applications utilizing four pounds of active Oxadiazon per acre occur right after all containers are hand weeded.

7. Polyhouse structures are continually looked over for structural problems and duly repaired.

October-November of the First Production Year

1. In preparation for overwintering, irrigation and fertilization is reduced to help harden off late summer growth.
2. Before complete covering and thereby sealing of the polyhouses, desired high mositure levels in the containers are obtained by late covering practices and proper irrigation management.
3. Containers are weeded before covering as ideal growing conditions for cool weather weeds will exist within the polyhouses. The summer application of Oxadiazon herbicide will be weakening and a heavy weed population could use necessary soil moisture from the container.
4. The polyhouses are covered. Approximately 10 labor hours are needed to cover and seal a 200′ X 20′ polyhouse for winter weather.
5. Once covered, three fumigant bombs (Chlorothalonil exothermic bombs) per polyhouse are set-off.
6. Where needed, plants are covered with a thermal blanket in the polyhouse. Of the five groups analyzed, this practice is considered desireable for groups 2 and 5 (Cotoneaster and Rhododendron). This takes about five hours per polyhouse.

December-February of the First Production Year and March of the Second

1. A slow release fertilizer is applied by hand at the rate of one and one-half tablespoons per two gallon container. This occurs before the microfoam is put on groups 2 and 5. Although not activated until warmer temperatures, this allows for some work activity in the slow winter months for full-time employees and lessens spring labor problems for early hand fertilizer application during busy shipping and planting months.
2. A second set of fumigant bombs are set off (Chlorothalonil 3-10M exothermic bombs per polyhouse) to insure proper control of fungus growth. The thermal blankets must be lifted for proper coverage.
3. Polyhouses are checked several times during the winter for damage to the polyhouse structure, polyfilm and plants inside. Repairs are effected where necessary.

April of the Second Production Year

1. Plants are hand weeded. This minimizes competition for

nutrients and sunlight and also prepares for a herbicide application.
2. A herbicide application of Oxadiazon, four pounds active per acre is applied.
3. Polyfilm is removed by hand either before new growth begins or after frost dates if plants have started to grow.
4. The irrigation system is activated as temperatures increase and plant growth requires added moisture within the enclosed polyhouses.

May-September of the Second Production Year

1. The two gallon containers are spaced out within the polyhouse frame-work and adjacent growing area between polyhouses. Spacing is approximately 13.5 inch center for group 1 (Juniperus), 15.0 inch center for group 2 (Cotoneaster), 18.0 inch center for group 3 (Taxus), 21.0 inch center for group 4 (Viburnum) and 18.0 inch center for group 5 (Rhododendron).
2. The irrigation system is used approximately 50 times during this time period as in the first growing season however, seven-tenths of the irrigation time is allocated as the growing area requirements have increased due to spacing. To allow for irrigation in growing areas adjacent to the polyhouses, semipermanent irrigation lines would be set up between the polyhouses for the growing months.
3. Liquid fertilization occurs at 200 ppm Nitrogen (using Urea 45-0-0) rate by the same procedure as in the first year of one hour water irrigation, three hours of soluble fertilizer injected into the water and finally one hour of plain water.
4. Insecticide/fungicide applications, are once again, applied six times during the growing season utilizing an air blast sprayer powered and pulled by a tractor. Application rates of insecticides, fungicides and herbicides remain constant between seasons, however due to the increased production area utilized in the second growing season a higher allotment of chemicals, labor and machinery charges are assessed.
5. Handweeding takes place twice during the growing season.
6. The herbicide, Oxadiazon at four pounds active per acre is applied directly after each handweeding. 7. An early light pruning takes place to keep plants compact and uniform in size.
8. Polyhouse repairs are completed as time permits.

October-November of the Second Production Year

1. Irrigation of containerized plants is reduced to harden new growth.
2. Fall sales of approximately 10 percent of the crop occur. This requires hand tagging of plants with plastic strip tags, loading the two gallon containers onto pallets set upon four wheel wagons and transporting them by tractor to the shipping area. A forklift then removes the pallets from the four wheel trailer and sets them with the balance of the customer's order. The plants are then loaded onto a semi-truck for shipment to their destination point, using a forklift and hand labor.
3. Containers are consolidated and irrigation lines between polyhouses taken down. Due to fall sales and losses of plant material during the growing season, only about 88 percent of the plants initially potted up have to be overwintered in the second year. Consolidation of the containers requires some to be moved into polyhouses holding a first year crop.
4. Polyhouses are covered. Covering a 200' X 20' polyhouse with four mil white polyfilm takes about 10 hours.
5. Where needed plants are covered with a thermal blanket. This is considered necessary for groups 2 and 5 (Cotoneaster and Rhododendron). This takes about five hours per polyhouse.
6. Plants are hand weeded.
7. A slow release fertilizer (one and one-half tablespoons of Osmocote 18-6-12, nine month) is applied to ensure an attractive weedfree plant for early Spring sales.
8. The polyhousees are fumigated using a fungicide, Chlorothalonil in exothermic bomb form. The thermal blankets must be lifted to ensure proper coverage.

December-February of the Second Production Year and March of the Third

1. All polyhouses are checked continuously for winter damage and repairs effected where needed.
2. Polyhouses are fumigated with three fumigant bombs per polyhouse (Chlorothalonil, 10M cu. ft.).
3. In late February and March, approximately 15 percent of the crop will be tagged with a plastic strip tag, loaded onto pallets on four wheeled trailers and pulled by tractors to the shipping area. At the shipping area the pallets of plants are placed by customer order. The pallets are then lifted by forklift to the end of the semi-truck and loaded by stacking can upon can by hand.

April of the Third Production Year

1. The irrigation system is utilized to maintain the remaining saleable plants as harvesting and polyhouse clean up are occurring.
2. Polyfilm on the polyhouses is removed as weather and plant development dictates.
3. The majority of the harvesting is completed during this month, approximately 50 percent.
4. This is the one month where tractors and forklifts for order pulling and loading become limiting factors and rental units are required to help in the equipment crunch.

May of the Third Production Year

1. Irrigation continues to maintain those plants still to be shipped. The slow release fertilizer that was added in early Winter still provides sufficient nutrients to keep the plants attractive and ready for immediate sales.
2. The balance of the crop, approximately 25 percent of the saleable plants, is harvested and loaded onto semi-trucks.

Note: As the last saleable plants are being harvested, a new crop is planted and takes over the space once occupied by this crop, thus completing the two year cycle. While there is some extension of a crop into a third production year, it does not interfer with placing the new crop. Thus one is able to keep to a two year production cycle.